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EIS for the KBS-3 system – non-technical summary

Updated October 2015

The applied-for activity

The original Environmental Impact Statement (EIS) for interim storage, encapsulation and final disposal of spent nuclear fuel is a part of Svensk Kärnbränslehantering AB's (SKB's) applications for permissibility and licences under the Environmental Code and the Nuclear Activities Act, which were submitted in March 2011. SKB applied for a licence to continue operating the existing interim storage facility for spent nuclear fuel (Clab) on the Simpevarp peninsula in Oskarshamn Municipality, and to build a plant sector for encapsulation adjacent to Clab. The two facilities will then be operated as a single integrated facility, designated Clink. Furthermore, SKB is also applying for a licence to build and operate a final repository in Forsmark in Östhammar Municipality, see Figure S-1. The EIS covered these facilities, including water operations and transportation to and from the facilities.

Consultations have been held in accordance with the provisions of the Environmental Code. The consultations are briefly described in the Environmental Impact Assessment.

The application under the Environmental Code has been supplemented four times, among other things with the following material related to the EIS:

April 2013: Studies, inventories and impact assessments relating to local water handling and water operations in Forsmark.

September 2014: Local aspects for Forsmark regarding water handling and water operations, the operations' impact on natural values and legally protected species and more details on other methods for final disposal.

March 2015: Additional application for a licence to increase Clab's interim storage from the current 8,000 tonnes of spent nuclear fuel to 11,000 tonnes. A so-called additional-EIS (including consultation accounts) was enclosed with the supplement describing the changes in Clink and the consequences of increased interim storage in Clab.

September 2015: Clarification of previously submitted responses to questions relating to the local environmental impact, post-closure safety and the continuing licensing process.

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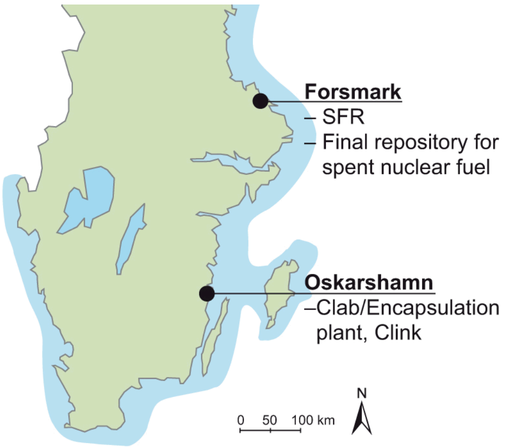

Figure S-1. SKB is applying for licences to build a plant sector for encapsulation adjacent to Clab on the Simpevarp peninsula in Oskarshamn Municipality and the final repository in Forsmark in Östhammar Municipality.

Background

Ever since the Swedish Nuclear Power Plants were commissioned, they have generated radioactive waste. The power plant owners are responsible for safe management and disposal of the waste and have jointly formed SKB for this purpose. SKB has been conducting research and developing methods to dispose of the waste for nearly 30 years. Today there is a final repository for short-lived radioactive waste (SFR) in Forsmark and a central interim storage facility for spent nuclear fuel (Clab) in Oskarshamn.

Nuclear fuel is made from uranium mineral. The radioactivity of the fuel increases sharply during the operation of a reactor. The fuel is taken out of the reactor after about five years, and is then at its peak radiotoxicity. Its radiotoxicity then declines as the radioactive substances decay. In its planning, SKB assumes that the reactors in Forsmark and Ringhals will be operated for 50 years and the reactors in Oskarshamn for 60 years. The Swedish reactors would then give rise to a total of about 12,000 tonnes of spent nuclear fuel.

Pre- and post-closure safety

The purpose of the applied-for activity is to dispose of the spent nuclear fuel in order to protect human health and the environment from the harmful effects of ionizing radiation from the spent nuclear fuel, now and in the future.

Nuclear facilities must comply with high standards of operational safety and radiation protection. Each facility has a safety analysis report that describes how safety and radiation protection are designed to protect man and the environment from radiation, both during normal operation and in the event of operational disturbances and accidents. Two fundamental principles are that radiation doses should be minimized as far as is reasonably possible and that the best available technology should be used.

The long-term post-closure safety of the final repository is a central issue in the licensing process and is described in a separate appendix to the applications. There SKB shows that the facility does not give rise to any significant environmental or health consequences in the future and thereby complies with the requirements of the Swedish Radiation Safety Authority. The long-term safety of the final repository is also described in the EIS.

The KBS-3 method

The method for disposing of the spent nuclear fuel is called KBS-3, see Figure S-2. KBS stands for KärnBränsleSäkerhet (Nuclear Fuel Safety) and 3 indicates that the method was presented for the first time in the KBS project's third main report. The method involves encapsulating the spent nuclear fuel in copper canisters which are deposited, surrounded by a buffer of bentonite clay, in deposition holes in a tunnel system about 500 metres down in the bedrock. The purpose of the three barriers (canister, buffer and rock) is to isolate the radionuclides in the fuel from the surrounding environment.

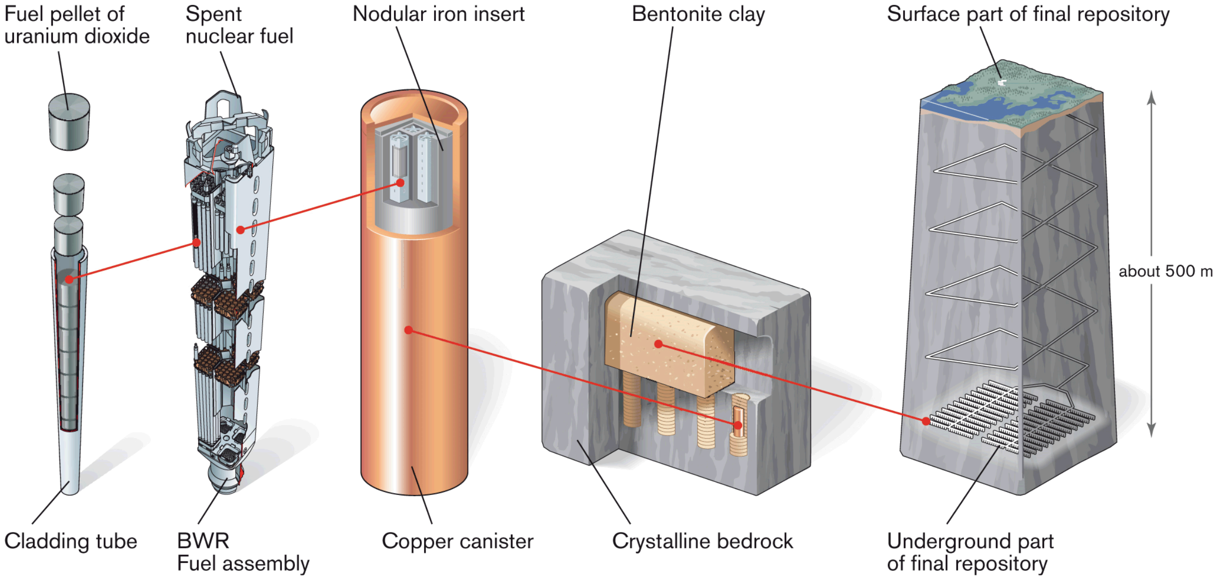

Figure S-2. The KBS-3 method. The method involves encapsulating the spent fuel in copper canisters which are then emplaced, surrounded by a buffer of bentonite clay, in deposition holes in a tunnel system at a depth of about 500 metres in the bedrock.

SKB's method development has been based on the requirements in Swedish legislation and the provisions of international agreements. In brief they are as follows:

- The owners of the nuclear power plants are responsible for managing and disposing of the nuclear waste in a safe manner.
- The waste must be dealt with within the country, if this can be done in a safe manner.
- The sea and the seafloor may not be used for this purpose.
- The system shall be designed to prevent illicit trafficking in nuclear materials or nuclear waste.
- Safety shall rest on multiple barriers.
- The final repository shall not require monitoring or maintenance.
- Management and final disposal of the nuclear waste shall in all essential respects be solved by the generations who have benefitted from the nuclear power.

The support and acceptance of the community is required if the plans for the final repository are to be realized. SKB's basic principle is therefore that siting shall take place with the voluntary participation of the concerned municipalities.

Siting of the final repository

The siting work began more than 30 years ago with the acquisition of knowledge on the Swedish bedrock and what properties the rock must have in order for the final repository to be safe. SKB conducted feasibility studies in eight municipalities between 1993 and 2000. Site investigations were initiated in 2002 and continued for about five years in Forsmark in Östhammar Municipality and in Laxemar/Simpevarp in Oskarshamn Municipality.

In June 2009, a systematic comparison of the conditions on the sites showed that all things considered, Forsmark is the site that offers the best prospects for achieving long-term safety. SKB therefore decided to submit licence applications for a final repository located in Forsmark.

Other methods and the zero alternative

SKB has also studied other ways to dispose of the spent nuclear fuel besides the KBS-3 method. None of the other methods satisfy all the fundamental requirements and criteria, or they are not available at today's level of knowledge and development.

If final disposal of the spent nuclear fuel does not come about, the remaining option is to continue storing it under monitored forms. This can be done either by continued storage in Clab, or by one of the other methods for monitored storage that are used internationally. With monitored storage, the environmental, safety and radiation protection requirements can be met as long as human monitoring with control and maintenance is maintained. For this reason, monitored storage is associated with uncertainties in a long time perspective. The method does not meet the fundamental requirements on a final repository, since it postpones the solution into an indefinite future. Continued storage in Clab is the so-called zero alternative in the EIS.

Description of the Forsmark area

The final repository will be located on the coast adjacent to the Forsmark industrial area, where the Forsmark Nuclear Power Plant is situated, see Figure S-3. Facilities belonging to the nuclear power plant include a water works, a sewage treatment plant, an oil depot, power lines, the Svalören near-surface repository for low-level waste and temporary housing. The industrial area also contains the final repository for short-lived radioactive waste (SFR) and the Port of Forsmark, which is serviced by the ship m/s Sigrid (replaced m/s Sigyn 2014).

At the end of 2014, SKB submitted applications under the Nuclear Activities Act and the Environmental Code for an extension of SFR. The extension will provide space for decommissioning waste from the Swedish nuclear facilities. The applications have a separate EIS and will be handled according to the Espoo Convention in their own order in a similar manner to the final repository for spent nuclear fuel.

The nearby area is sparsely built-up, and no one lives within a distance of one kilometre from the planned operations area.

There are a number of national interests in the Forsmark area, one of which is the national interest for final disposal of spent nuclear fuel. Parts of the area that may be affected by the final repository are also of national interest for nature conservation and are subject to the Environmental Code's special management provisions for highly developed coastal areas.

S-3. View over the Forsmark area with the nuclear power plant in the foreground.

In the site investigations which SKB has conducted, large resources have been devoted to gathering data in the field on the properties of the bedrock, the soil layers and the ecosystems. In order to fully characterize the rock, investigations on the surface have been combined with studies of drill cores and measurements in boreholes. Information on the soil layers has been obtained from soil wells. The results of the investigations have been summarized in site descriptive models.

The bedrock in the investigation area consists of the northwestern portion of a tectonic lens, i.e. an area in the bedrock where conditions have been geologically stable compared with surrounding deformation zones. The dominant rock type is medium-grained metagranite.

There are long, water-conducting horizontal fractures within the upper approximately 150 metres of the rock. At depths greater than 400 metres, the average distance between water-conducting fractures is more than 100 metres and the groundwater flow is limited. Due to these conditions, along with the area's gently dipping topography, most of the groundwater flows take place relatively close to the ground surface, without much exchange with deeper groundwaters.

Lime-rich till is the predominant Quaternary deposit in the soil layers. The water table is situated near the ground surface. There are many lakes and wetlands in the area, but no major rivers or streams. Most lakes are small and shallow, with lime-rich and nutrient-poor water.

The Forsmark area has an unusual wilderness character for Uppland, even though parts bear the traces of large-scale agriculture. The natural values in the area consist of land uplift habitats with high botanical and ornithological values, coastal water habitats, different types of rich fens and ponds, natural forests and farming and agricultural districts with pasturelands. The natural values in the area have been inventoried and classified by means of a methodology used by the Swedish Environmental Protection Agency and the county administrative boards. The red-listed pool frog occurs in some ponds in the area. Other red-listed species also occur in the area, including birds, orchids and fungi.

A cultural environment analysis, including an archaeological survey and a landscape analysis, has been carried out. Much of the cultural environment in the area is characterized by having belonged to Forsmarks bruk (former ironworks). Since the area in question only rose above the sea a few thousand years ago, there are no prehistoric or early medieval remains.

The area’s recreational value lies above all in its pristine nature, bird life and other animal life. Recreational activities such as hunting and fishing are popular. However, outdoor activities are not as extensive here as in other, more densely populated parts of the east coast.

Radiological measurements are performed regularly around the nuclear facilities in Forsmark. Most of the measured radiation consists of natural background radiation. The contribution from the nuclear power plant and SFR is about one five-thousandth of the natural background radiation, or approximately one five-hundredth of the legal limit.

Motor vehicle traffic in Östhammar is seasonally dependent and increases markedly in the tourist season summertime. Many residents along national road 76 between Forsmark and Hargshamn are exposed to noise levels above the guideline values, and the traffic noise is experienced as disturbing.

Description of the Oskarshamn area

The Laxemar/Simpevarp area in Oskarshamn has been surveyed by means of a site investigation similar to that in Forsmark. In this document, however, the site conditions are mainly described against the background of the siting of Clab and the planned plant sector for encapsulation, see Figure S-4.

The Oskarshamn Nuclear Power Plant with associated activities, including a near-surface repository for low-level waste and a rock cavern for interim storage of low- and intermediate-level waste, are situated on the Simpevarp peninsula. Clab, SKB’s site investigation office, the access tunnel to SKB’s hard rock laboratory on Äspö and the Simpevarp harbour, which is serviced by m/s Sigrid (replaced m/s Sigyn 2014) are also located on the peninsula.

The nearby area is sparsely built-up. The nearest residential development is in Åkvik, about 600 metres southwest of Clab.

The Simpevarp peninsula and its surrounding area contains a number of different sites of national interest, and the Natura 2000 site Figeholm is located along county road 743.

S-4. View over the Laxemar/Simpevarp area with the nuclear power plant in the background.

The area around the Laxemar and Simpevarp subareas lies in a geographical region which is characterized by a joint valley landscape with small elevation differences, hardwood forests, bare skerries and rocky shores. The natural values in the area have been classified using the same method as in Forsmark. There are no natural areas on the Simpevarp peninsula that have been judged to be valuable.

The cultural heritage assets on the peninsula consist of numerous archaeological remains, including cairns and stone circles from the Bronze and Iron Age. Near Clab there are archaeological remains in the form of five prehistoric graves, indicating that there may also be remains of permanent settlements.

Radiological measurements around the nuclear facilities are performed in a similar manner as in Forsmark. The nuclear power plant's emissions are less than one hundredth of the legal limit. Clab's contribution is virtually negligible.

County road 743, which is heavily trafficked during certain periods, is used for shipments to the Simpevarp peninsula. Many residents along the way from the Oskarshamn Nuclear Power Plant to the Port of Oskarshamn are exposed to noise levels above the guideline values for road traffic noise.

Clab

Facility and activity

At present approximately 6,000 tonnes of uranium from over 40 years of operation of the Swedish nuclear power plants is being stored in Clab. Certain used high-level components from the nuclear power plants are also being stored there. Clab has been in operation since 1985 and was extended in the early 2000s with a new rock cavern, which was put into operation in early 2008, see Figure S-5.

Storage in Clab takes place in pools located in rock caverns about 30 metres underground. During storage, the radioactivity and heat output of the nuclear fuel decline, facilitating further handling. The water in the pools provides protection against radiation while cooling the fuel. The water in the pools is in turn cooled by sea water in a system of heat exchangers.

Figure S-5. Clab is situated on the Simpevarp peninsula.

The spent nuclear fuel and spent core components are transported from the nuclear power plants to Clab enclosed in special transport casks, which are designed to withstand severe accidents without consequences for the environment. Transport takes place by sea on m/s Sigrid to the Simpevarp harbour and overland on specially built vehicles.

SKB has a licence to store 8,000 tonnes of spent nuclear fuel in Clab. With today’s forecasts, the permitted amount will be reached by about 2023, which is several years before the Spent Fuel Repository will be put into operation. This means that there is a need to extend the permitted interim storage amount so that reception of spent nuclear fuel in Clab can continue even after 2023. Therefore, SKB submitted in March 2015 a supplement with an additional application for a licence to increase Clab’s interim storage from the current 8,000 tonnes of spent nuclear fuel to 11,000 tonnes.

It is possible to increase the interim storage of spent nuclear fuel in the existing pools to 11,000 tonnes with relatively simple measures. This can be achieved by storing all fuel in so-called compact storage canisters, with the aid of segmentation being able to package the core components closer together and removing the core components from the pools for interim storage at another site pending final disposal in SFL.

A premature closure of four nuclear reactors is planned in Sweden, which would affect the time point at which Clab is full.

Impact, effects and consequences

Operational safety and radiation protection

Releases of radionuclides to air and water take place continuously, but are far below the legal limits and are not judged to give rise to any health consequences whatsoever for nearby residents. The exhaust air from spaces where radioactivity may be present is cleaned by filters, which remove most of the particle-borne radioactivity. The emissions of airborne radioactivity from the facility leave Clab via the ventilation chimney, where monitoring equipment continuously registers radioactivity releases.

Discharges of water-borne radioactivity only take place via the water purification system from the area where radioactivity can occur (the controlled area). The water is purified by filters and ion exchange resins, and the radioactivity content of the water is checked prior to each discharge.

An increase of the interim-stored amount of spent fuel to 11,000 tonnes will only produce marginal yearly increases of releases and dose, since fuel will be received and processed at approximately the same rate as before.

Radioactive waste

Radioactive waste in the form of protective clothing, ion exchange resins etc is collected and taken to a near-surface repository or to SFR.

Discharges to water

Heated water that has been used to cool the facility is discharged into Hamnefjärden Bay. Water from Clab is discharged along with cooling water from the Oskarshamn Nuclear Power Plant and constitutes only a fraction of the total discharge (in the order of a tenth of a percent).

Groundwater that flows into the rock caverns is pumped and discharged into Herrgloet Bay. Both the water in the cooling system and inflowing groundwater are kept outside of the controlled area and therefore do not contain any radioactive substances.

Other environmental consequences

Neither Clab nor shipments to and from the facility are judged to affect any national interests or protected areas.

Clab’s visual impact on the landscape is limited thanks to the surrounding forest. The noise level at the facility is low and is not judged to cause any consequences for the local populace.

The local drawdown of the groundwater caused by the facility is limited in scope and extent and has not given rise to any consequences for either natural values or groundwater levels in wells.

Clink

Facility and activity

The plant sector for encapsulation will be erected immediately adjacent to Clab, see Figure S-6, and the two facilities will be operated as a single integrated facility, called Clink. Existing functions and systems in Clab will be co-utilized wherever possible.

Spent nuclear fuel will be encapsulated in the encapsulation sector prior to final disposal in the bedrock. The nuclear fuel will be taken out of the storage pools in Clab, dried and placed in copper canisters, after which a lid will be welded on. The canisters, which are around five metres long, will arrive at the plant ready-made. The plant is designed for a production capacity of 200 filled canisters per year, i.e. around one canister per work day.

Filled canisters are placed in transport casks and transported by sea to the final repository. The function of the canister in the final repository is to enclose and isolate the spent nuclear fuel.

When nuclear power has been phased out and all spent nuclear fuel and other high-level waste has been transferred to the final repository, Clink will be decommissioned. SKB’s current estimate is that decommissioning can begin in around 2070.

Figure S-6. The plant sector for encapsulation will be located directly adjacent to Clab, and the two facilities will be operated as one integrated facility called Clink. The red outline indicates the part of the picture that is a photomontage.

Impact, effects and consequences

Operational safety and radiation protection

The amount of radioactivity that is released per fuel assembly is much less in the encapsulation sector than in Clab, despite the larger volume of fuel and transport casks handled. This is because the radioactivity of the fuel has declined during the long period of storage. Once the fuel has been encapsulated it is no longer a source of airborne radioactivity, but radiation shielding is nevertheless required during its further handling.

The radioactivity released during handling in the pools in the encapsulation sector is collected on filters and ion exchange resins in a water purification system common for Clink. In areas where airborne radioactivity is expected, the ventilation system is equipped with filters. Airborne emissions from the encapsulation sector will take place through a ventilation chimney, and the radioactivity in the emitted air will be monitored continuously.

Clink's emissions to air and water are expected to be far below the legal limit and will not give rise to any health consequences for nearby residents or for the flora and fauna in the nearby area.

SKB has, at the request of the Swedish Radiation Safety Authority (SSM), made a revision to the set of requirements for Clink. Among other things the nuclear accident at the nuclear power plant Fukushima Dai-ichi in March 2011 led SSM to announce that higher safety requirements will be made on new nuclear facilities. The changes have produced an altered facility design both above and below ground. The new facility design means, among other things, extended earthquake protection for buildings and systems, and that buildings have better protection against for example an airplane crash. This is described in the supplement to the applications submitted to the Land and Environment Court in March 2015.

Radioactive waste

Radioactive waste from Clink will be managed in the same way as waste from Clab.

Land use

The plant is not expected to affect any national interests or protected areas.

When the encapsulation sector is built, land is needed for the plant itself along with temporary establishment areas for construction, for a total of nearly 30,000 square metres. Land will be used west of Clab, in a forested area without any high natural values.

In view of the archaeological remains in the form of graves found in the siting area and the nearby Bronze Age cove, it is not unlikely that prehistoric settlement sites may be affected.

Since there is already an established industrial environment on the Simpevarp peninsula, it is judged that more large-scale facilities can be built on the peninsula without altering the character of the area. The consequences for the landscape will be small, as long as the forest surrounding the facility is spared.

Transportation, noise and vibration

Construction of the plant sector for encapsulation will give rise to noise and vibrations. No appreciable disturbances are expected as a consequence of the vibration. Noise calculations show that the construction noise will not exceed the guideline value at the nearest homes, even in a worst case scenario, if noise barriers are built.

Due to noise from road transport, a maximum of 40 or so residents will be exposed to sound levels above the guideline value during construction of the encapsulation sector. There will be more events with peak sound levels when the number of heavy vehicles increases. Vibrations from shipments to and from the plant are not expected to lead to any appreciable disturbance for residents along the transport routes.

During the operating phase, the noise situation in the area will be similar to what it is today. Noise suppression measures will be adopted on fans, and the guideline value for industrial noise will not be exceeded, which means that no significant disturbance for nearby residents is expected.

The impact of the changes due to increased rock excavation, claiming of land etc, is limited and the consequences are small and local. Previous descriptions of consequences for Clab and Clink in the original EIS are not judged to be affected to any significant extent and thereby neither the consequences for the KBS-3 system as a whole.

Other emissions to air and water

Conventional atmospheric emissions that occur from Clink (including transport emissions) are not expected to be of such a scope that they will entail any risk to health or exceed the environmental quality standard for air. Sea transport of fuel-filled canisters to the final repository will be the predominant source of atmospheric emissions.

The temperature in Hamnefjärden is elevated today due to the discharge of cooling water from the nuclear power plant, and the contribution from Clink will be marginal.

Energy and resource consumption

Heat for heating of the encapsulation sector can be extracted from the cooling water in Clab. The facility needs to be cooled in the summertime, and the excess thermal energy is then discharged to the sea.

It is estimated that approximately 44,000 tonnes of copper will be consumed in the encapsulation of the spent nuclear fuel over a 40–50-year period, which can be compared with the annual global production of copper of 15.5 million tonnes.

Final repository

Facility and activity

The final repository will consist of a surface part and an underground part. The surface part includes an operations area with the central functions for the operation of the facility. The operations area will be situated on the coast, just southeast of the nuclear power plant in Forsmark, on a site which SKB calls Söderviken, see Figure S-7. A rock heap will be established next to the operations area, along with facilities for water treatment.

The underground part's central area will be located directly beneath the operations area. From here it will be possible to access the repository area, consisting of main tunnels and deposition tunnels with deposition holes in which the copper canisters will be emplaced, surrounded by a buffer of bentonite clay. The surface and underground parts will be connected by ventilation and elevator shafts, plus a ramp for vehicle transport.

Construction of the facility will take approximately seven years and employ around 300–400 persons. Activities will be most intensive during the second half of the construction phase. A total of about 1.6 million tonnes of rock spoil will be excavated during the construction phase. The rock spoil will be temporarily stored in a rock heap within the industrial area. It is believed that the surplus that is not needed in the project can be sold in the region. Since the original EIS was submitted in 2011, further design work has shown that excavation of rock may be somewhat higher than 1.6 million tonnes.

The operating phase is divided into two sub-phases, trial operation and routine operation, both of which require a licence from the Swedish Radiation Safety Authority (SSM). Routine operation is expected to last about 45 years. The main activities during routine operation are detailed characterization, mining of deposition tunnels, deposition of canisters, and backfilling and plugging of deposition tunnels. Approximately 6,000 canisters will be deposited during the operating phase.

Figure S-7. Location of the final repository on Söderviken in Forsmark (photomontage). The Forsmark Nuclear Power Plant can be seen to the left in the picture, and the area at the bottom is the rock heap. The red outline indicates the part of the picture that is a photomontage.

When all canisters have been deposited, the facility will be backfilled and closed. Altogether it is estimated that the repository's tunnels will occupy an area of 3–4 square kilometres at a depth of about 470 metres.

During the operating phase, filled canisters will be transported from Clink to the final repository by m/s Sigrid.

Impact, effects and consequences

Operational safety and radiation protection

As long as the canister remains intact, no radioactive substances can escape. The canister is designed to withstand normal operation, disturbances and mishaps without a penetrating breach occurring that leads to release of radioactivity. However, the canister does emit gamma and neutron radiation and will therefore be handled with radiation shielding to protect the personnel. The radiation emitted by the canister does not have enough range to reach outside of the final repository.

Post-closure safety

According to SSM's regulations, post-closure safety will be achieved by means of a system of passive barriers that interact to contain, prevent or retard the dispersal of radioactive substances. The barriers may be engineered or natural. In addition there are regulations that stipulate what protective capability the final repository should have. An important requirement is SSM's risk criterion, which in simplified terms says that people in the vicinity of the repository may not be exposed to greater risks than the equivalent of one-hundredth of the natural background radiation in Sweden today. The analysis of the long-term post-closure safety of the repository shows that the regulatory requirements are satisfied. The aggregate risk for a final repository in Forsmark is well below the risk criterion, even in a time perspective of a million years.

National interests and protected areas

Most of the sites of national interest in the area are either not affected by, or deemed not to be harmed by, the planned activity. The Forsmark-Kallrigafjärden site of national interest for nature conservation risks being affected by a possible groundwater drawdown, with consequences for rich fens and shallow ponds. The risk of significant effects cannot be excluded, but a number of measures are planned to limit the consequences for the natural values in the area.

Land use

Most of the facility is located in areas that are already industrial land today, but land with high natural values will also be included. Three ponds, two of which are deemed to be of national interest because the red-listed pool frog has been observed, will be filled. To compensate for these ponds, SKB has dug six new ponds nearby.

No areas with bird life worthy of protection are judged to be affected by SKB’s land needs. Disturbances of bird life can, however, result from the movement of people in the area. SKB will therefore implement restrictions, training and recommendations for employees who need to get to or move around in areas that are used for nesting by protected and red-listed species.

Cultural environment

Söderviken and its environs do not harbour any special cultural heritage values. No known archaeological remains are affected, and the probability that unknown archaeological remains might be affected is considered very low.

There are, however, a couple of historical remains near the siting area and the ventilation stations. They are judged to be possible to protect from development and are therefore not affected.

Landscape

The final repository will be built adjacent to the nuclear power plant, whose three large reactor units are landmarks that can be seen from a great distance in the flat wooded and coastal landscape. The final repository’s largest buildings will be smaller and lower than the reactor units. The facility will nevertheless be visible from far away, mainly from the sea. The area’s existing industrial character will be preserved and the consequences for the landscape are therefore deemed to be small.

Discharges to water

The activity will give rise to polluted water that needs to be managed during both the construction and the operating phase. Storm water will be managed locally. Leachate from the rock heap will be treated to remove oil and particles. In the original EIS it was stated that leachate from the rock heap after treatment would be released into a small lake (Tjärnpussen). After completion of inventories in 2011, it was discovered that wetlands that have hydrological contact with the lake harbour high natural values including the protected fen orchid. As a consequence, Tjärnpussen is no longer a suitable recipient and the information about this in the EIS is no longer valid. Leachate from the rock heap will instead be conducted to the nuclear power plant's new cleanup plant for sewage. This is described in the supplement to the applications submitted to the Land and Environment Court in April 2013.

The drainage water that is pumped from the tunnels consists for the most part of groundwater, but also contains flushing water from the blasting. The drainage water will be treated underground by sedimentation and oil separation and then discharged into Söderviken. The heat content of the drainage water will be used to heat the supply air to the underground facility. The effects of the discharge are expected to be limited, since the content of nitrogen residues is judged to be low and the receiving body of water is relatively tolerant.

Groundwater level and wetlands

During work underground, the rock will be sealed by grouting where fractures and fracture zones are present. Completely preventing groundwater inflow into the facility is not possible, however, since grouting can never make the rock completely watertight. The leaking groundwater will cause groundwater drawdown, which can in turn affect water levels in wetlands. The affected area consists of a number of “swaths” that run in an east-west and north-south direction above the repository, and in areas around the cooling water channel. Most inventoried wetlands in Forsmark are deemed to be sensitive to a lowering of the groundwater table. Even moderate drawdowns of less than a decimetre cause a change in the vegetation towards drier types, and in the long run invasion by shrubs and trees. During their reproductive period, the pool frog and other amphibians are particularly sensitive to drying-out of the ponds. Seven of the ten highest classified wetland sites (national value) in the investigation area are located within or next to the impact area. Groundwater drawdown is judged to entail very great consequences for two sites (of national interest), great consequences for 15 sites and noticeable consequences for eight sites if no measures are adopted. Measures in the form of water supply to the most sensitive and valuable wetland sites are planned to mitigate the possible consequences.

Transportation, noise and vibration

Construction activities, rock handling and transport activities within the industrial area will give rise to noise. The noise will affect a forested area within an area of national interest for outdoor activities. The value of the area in question for outdoor activities is deemed to be low, however. No homes with part-time or permanent residents are affected.

Road traffic to and from the final repository consists for the most part of commuting, but haulage of material and rock spoil will also occur. The heaviest traffic will occur during the second half of the construction phase, when around 90 rock shipments per day may pass, including empty trucks to collect the rock spoil.

The road traffic noise along national road 76 is already perceived as disturbing by the residents along the road. The heavy traffic to and from the final repository will lead to an increase in the number of residents exposed to noise levels above the guideline value, at most about 20 persons. The increase will mainly occur in Johannisfors, Norrskedika and Börstil. Sleep disturbances are not expected to increase due to the transport noise, since the heaviest traffic will be in the daytime.

Heavy shipments may cause vibration along the transport routes. The vibration levels will not increase, but there will be more heavy vehicle passages. The vibration levels may entail a risk of moderate disturbance in a few buildings along national road 76.

Emissions to air

The final repository and associated transport activities will give rise to atmospheric emissions in the form of e.g. carbon dioxide, nitrogen oxides and particulates. The amounts and dispersal of the emissions have been determined and are not judged to give rise to any appreciable consequences for human health or the environment. The legal limits that exist for air quality (environmental quality standards) are not expected to be exceeded as a result of the final repository and associated transport activities.

Energy and resource consumption

Ventilation is responsible for a large portion of the energy consumption expected at the facility and will therefore be need-controlled, which means that ventilation will be minimized when the facility is not in operation.

The need for bentonite clay is estimated to be around 50,000 tonnes per year or a total of 2.3 million tonnes during the operating life of the facility. The total global production of bentonite in 2007 was 15.7 million tonnes.

There are no bentonite mines in Sweden, which means that the material must be imported. The planned port of entry is Hargshamn, about 30 kilometres south of Forsmark.

Siting alternatives considered

Clab

The siting of Clab was studied in the 1970s. Changing the existing siting has not been judged to be environmentally or economically defensible, and for this reason no siting alternatives for Clab are subjected to impact assessment in this EIS.

Encapsulation plant

As an alternative to siting the plant sector for encapsulation adjacent to Clab on the Simpevarp peninsula, a siting of an encapsulation plant in the vicinity of the Forsmark Nuclear Power Plant has been studied. The stored nuclear fuel in Clab would then be transported there for encapsulation and Clab would need to be complemented with equipment in order to be able to dry the fuel. The fuel would then be handled dry, and no rock caverns with handling pools would need to be excavated in Forsmark.

An encapsulation plant, whether on the Simpevarp peninsula or in Forsmark, is not judged to entail any appreciable consequences or risks. The two alternatives are thereby largely equivalent from an environmental and health viewpoint. The advantages of a siting adjacent to Clab are that the personnel already have experience of handling the fuel and that several technical systems can be utilized jointly.

Final repository

A siting in Laxemar, next to Simpevarp in Oskarshamn, is described in the EIS as an alternative siting of the final repository. The consequences for the natural environment would then be less, the facility would not affect any natural values of national interest, and the Laxemar area is not as sensitive to groundwater drawdown as the natural values in Forsmark.

The consequences for the residential environment and human health are judged to be slightly greater in Laxemar, since more people there live along the transport route. The consequences for the cultural environment and the landscape are also judged to be greater in Laxemar than in Forsmark, since an establishment there would entail creation of an industrial area in a relatively pristine forest and agricultural landscape.

The biggest difference between Forsmark and Laxemar is the greater water throughflow at repository depth in Laxemar. The water throughflow is important since it can transport solutes to the buffer and canister, which can affect the long-term function of the buffer and the canister. Due to the larger water throughflow in Laxemar, safety-related conditions are poorer there than in Forsmark. A comparative assessment of long-term safety shows that a final repository in Forsmark complies with SSM's risk criterion with good margin while this is not the case for Laxemar.